Mathematically modeling species dispersal

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Dispersal is an ecological process involving the movement of an organism or multiple organisms away from their birth site to another location or population where they settle and reproduce. An important topic in ecology and evolutionary biology, dispersal can either be random or directed. Random movement, as the name indicates, describes dispersal patterns that are unbiased and random, whereas directed or biased movement occurs when organisms sense and respond to local environmental cues by moving directionally. Dispersal is dependent on a variety of factors such as climate, food, and predators, and is often biased.

Fitness-dependent dispersal is a type of biased dispersal; the fitness of a species is given by its per capita growth rate. In many mathematical models of fitness-dependent dispersal, movement of organisms into and out of an area or region depends on the fitness differences between the organisms' resident patch and other patches in the habitat, and there is a net movement from patches of lower to higher fitness. In a recent paper published in the *SIAM Journal on Mathematical Analysis*, authors Yuan Lou, Youshan Tao, and Michael Winkler propose a continuous-time and continuous-space reaction diffusion model for fitness-dependent dispersal where the species moves upward along its fitness gradient.

In ecology, ideal free distribution refers to the way in which organisms distribute themselves among patches proportional to the amount of resources available in each patch. Such a distribution minimizes resource competition and maximizes fitness. Thus it is natural to expect that dispersal strategies leading to ideal free distribution of populations would be favored over the course of evolution. The authors, in this paper, determine that fitness-dependent dispersal conveys advantages to approaching such ideal free distribution.

More information: Approaching the Ideal Free Distribution in Two-Species Competition Models with Fitness-Dependent Dispersal, *SIAM Journal on Mathematical Analysis*, 46 (2), 1228-1262. epubs.siam.org/doi/abs/10.1137/130934246

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